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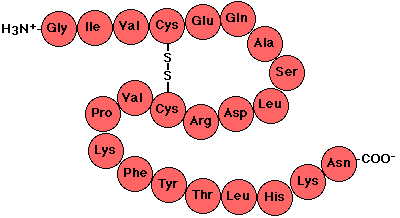
**Unit 6, Part 1 Notes – DNA History and Structure**

Pre-AP Biology, Mrs. Krouse

**DNA History:**

1. **Question:** Why did scientists originally think protein was the genetic material (aka genetic molecule) of the cell?

**Question:** What do we mean when we say “genetic material?”



1. Proteins are made of various combinations of 20 different amino acids connected in long polypeptide chains (see image to the right). A typical protein has multiple polypeptide chains folded around each other.
2. Review from our Biochemistry Unit (Unit 2)…

**Question:** What do we call the building blocks of the four macromolecules (carbohydrates, lipids, proteins, and nucleic acids)? (Hint: Amino acids are examples of these building blocks.)

**Question:** What do we call chains of building blocks of the four macromolecules? (Hint: polypeptides are an example of these building blocks)

1. In Frederick Griffith’s experiment, he worked with two strains of pneumonia bacteria—R and S strain pneumonia bacteria. He used these strains of bacteria to infect mice in several different trials

The S strain has a smooth outer coating called a capsule that prevents it from being destroyed by the mouse’s immune system. Because of this, it is virulent (can cause disease in the mouse).

*Note: It is called the S strain because S stands for smooth!*

The R strain does not have a smooth capsule to prevent it from being destroyed by the mouse’s immune system. Because of this, it is non-virulent (not harmful to the mouse).

*Note: It is called the R strain because R stands for rough. The surface of these bacteria is rough due to the absence of the smooth capsule.*

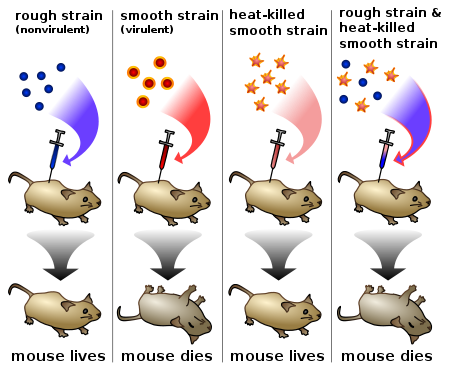
1. In Griffith’s first trial he injected a mouse with R strain bacteria. The mouse lived because the R strain was non-virulent (aka non-pathogenic). *See image on the next page.*

In Griffith’s second trial he injected a mouse with S strain bacteria. The mouse died because the S strain was virulent (aka pathogenic). *See image on the next page.*

In Griffith’s third trial he “heat killed” his S strain bacteria. This means he killed the bacteria using high temperatures. He injected a mouse with heat-killed S strain bacteria. The mouse lived because the bacteria were dead and therefore not harmful to the mouse. *See image on the next page.*

In Griffith’s fourth trial he injected a mouse with a mixture of living R strain and heat-killed S strain bacteria. The mouse died. *See image below.*

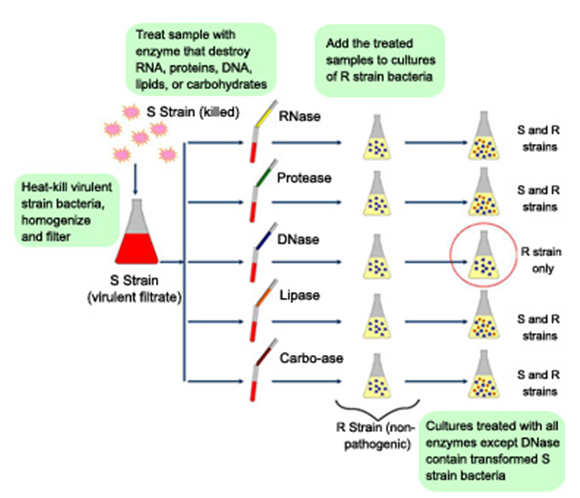
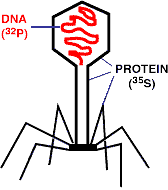
**Question:** Why did the mouse in the fourth trial die? (Use the word “transformation” in your answer).



1. After Griffith conducted his experiments, Oswald Avery, Maclyn McCarty, and Colin Macleod set out to determine what type of molecule was used to transform R strain bacteria into S strain bacteria.

They conducted several trials in which they used enzymes to destroy different molecules in the heat-killed S strain bacteria. The molecules they destroyed in these different trials were RNA (a type of nucleic acid), proteins, DNA (a type of nucleic acid), lipids, and carbohydrates).

*Remember: Enzyme names typically end in “ase.”*

1. **Question:** Describe the results of the Avery, McCarty, and Macleod experiment.
2. **Question:** What did these scientists conclude from their results?
3. Alfred Hershey and Martha Chase conducted experiments with viruses to determine which molecule was the genetic material of viruses.

**Question:** Describe the structure of viruses.

1. Hershey and Chase worked with viruses that infect bacteria cells. They wanted to determine which molecule in the viruses (i.e. DNA or protein) was injected into the bacteria cells during infection. The molecule that gets injected into the host bacteria cell is the genetic material of the virus, and it is used by the host cell to make many baby viruses. These baby viruses eventually burst out of the host cell, killing it. The baby viruses then find their own host cells to infect.
2. In their first trial, they radioactively labeled a form of sulfur (35S) found in the protein coat of the virus and then allowed the virus to infect the bacterial host cell. (Note: Sulfur is not found in DNA.)

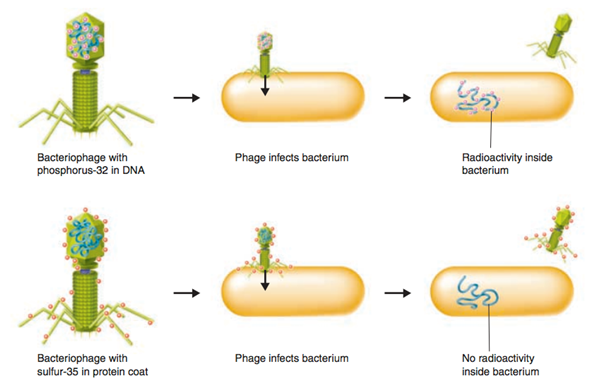
**Question:** Describe the results of this trial.

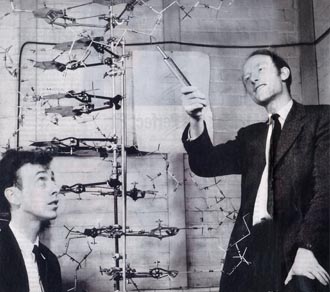
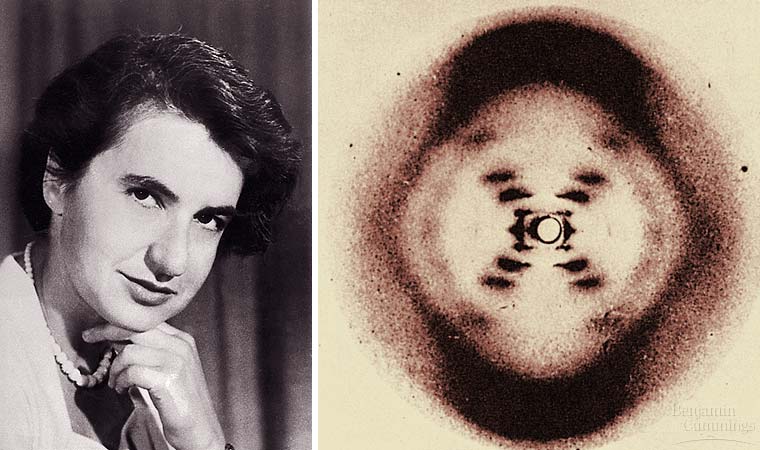
**Question:** What did Hershey and Chase conclude from the results of this trial?

1. In their second trial, they radioactively labeled form of phosphorus (32P) found in the DNA of the virus and then allowed the virus to infect the bacterial host cell. (Note: Phosphorus is not found in protein.)

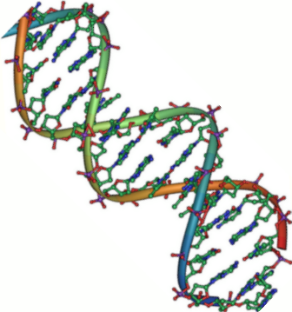
**Question:** Describe the results of this trial.

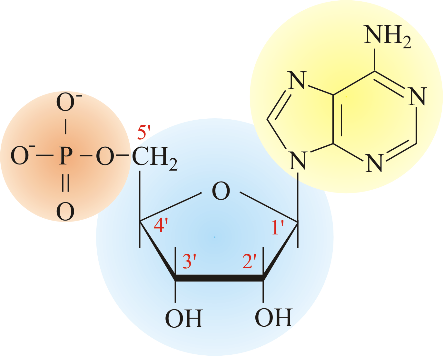
**Question:** What did Hershey and Chase conclude from the results of this trial?

1. **Question:** What was Hershey and Chase’s overall conclusion from their experiment?
2. Rosalind Franklin and Maurice Wilkins took x-ray crystallography images of DNA molecules (see below, left). Their images were analyzed by James Watson and Francis Crick (see below, right) who determined that the basic structure of DNA was a double helix.

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**DNA Structure:**

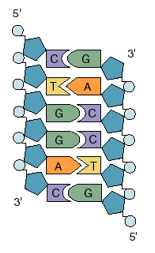
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1. **Question:** DNA is an example of which type of macromolecule (carbohydrate, lipid, protein, or nucleic acid)?
2. The full name of DNA is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
3. DNA is made of monomers called \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
4. **Question:** What is the function of DNA?
5. DNA is made of two coiled chains of nucleotides called the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
6. Each nucleotide is made of 3 parts. List the three parts below and label the parts of the nucleotide pictured to the right.

A.

B.

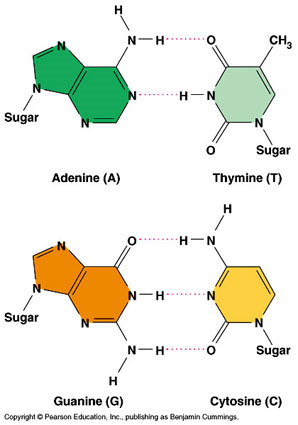
C.

1. When untwisted, the DNA double helix looks like a ladder (see image below). The “backbone” of each chain of nucleotides in the double helix (i.e., the sides of the ladder) is made of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ bonded to \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
2. The “rungs” of the ladder are made of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ bonded together by weak \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ bonds. (Note: The rungs of a ladder are the bars in the middle that you put your feet on to climb).
3.  Label a **sugar, phosphate, and base** in the picture to the right.

20. The part of each DNA strand (one side of the double helix, which consists of a chain of nucleotides) that ends with the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ is called the **5 prime (5’) end**. (Hint: **Ph**osphate = **F**ive)

The part of each DNA strand that ends with the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ is called the **3 prime (3’) end.**

21. Explain the meaning of the following statement…“The strands of the double helix are **antiparallel**.”

22. There are 2 types of nitrogenous bases. \_\_\_\_\_\_\_\_\_\_\_\_\_\_ have a **double-ring structure**, and \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ have a **single-ring structure**. 

23. The two **purines** are \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ and \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

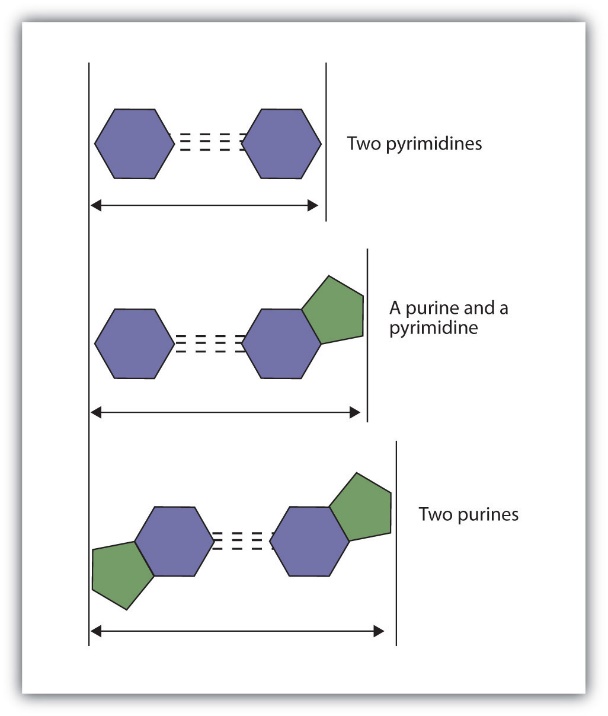
24. The two **pyrimidines** are \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ and \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

25. Purines can only pair with pyrimidines across the DNA double helix. They are connected by \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ bonds. (see image to the right)

**Questions:**

How many bonds connect adenine and thymine?

How many bonds connect guanine and cytosine?



26. **Question:** Why would it be a problem for the double helix structure if purines paired with purines and pyrimidines paired with pyrimidines? (see image to the right)

27. How do we know that adenine pairs with thymine and guanine pairs with cytosine? Well, a scientist named Erwin Chargaff determined the frequency (percentages) of each nitrogen base in the DNA double helix. These frequencies were…

A = \_\_\_\_\_ %

T = \_\_\_\_\_ %

C = \_\_\_\_\_ %

G = \_\_\_\_\_ %

**Question:** What did he conclude based on these frequencies? (Use the term “complementary base pairing” in your answer.)

28. **Question:** If there is 30% adenine in a particular DNA molecule, how much cytosine is present?

29. **Question:** Write out the nitrogen base sequence of a DNA strand complementary to the following strand.

T T A G C A T G G